United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA 832-F-99-072 September 1999

Water Efficiency Technology Fact Sheet
Incinerating Toilets

DESCRIPTION

Incinerating toilets are self-contained units consisting of a traditional commode-type seat connected to a holding tank and a gas-fired or electric heating system to incinerate waste products deposited in the holding tank. The incineration products are primarily water and a fine, non-hazardous ash that can be disposed of easily and without infection hazard.

APPLICABILITY

Though traditional water-flushing toilets are widely used throughout developed regions of the world, their use is not always feasible. For example:

- In rural areas where no municipal sewage system exists, or where installation of septic systems is impractical or prohibitively expensive due to shallow soils, steep slopes, high groundwater levels, or extreme cold weather conditions.
- For remotely located roadside rest areas, where connection to a piped sanitary system is impractical and the cost unjustifiable.
- For work crews operating in areas where permanent toilets are not available.
- In marine vessels, for which discharge of untreated waste into bodies of water is prohibited; human wastes must either be stored in tanks while at sea or be treated prior to discharge.
- In areas where water is scarce due to drought or other environmental conditions and the need to conserve water motivates consideration of alternative, water-free toilet systems.
- Where community, environmental, and health organizations have concerns regarding existing sewage disposal practices, especially seepage of contaminants into local water supplies from improperly functioning septic or other treatment systems, or exposure of residents to improperly dumped waste products from rudimentary collection pails called “honey buckets.”

All of these situations are potentially suited to the use of incinerating toilets which are portable, water-free, and sanitizing.

ADVANTAGES AND DISADVANTAGES

Often touted as a “pollution-free” technology, incinerating toilets have some clear advantages over many traditional methods of sewage disposal. There are also disadvantages that should be considered.

Advantages

- Uses no water.
- Incineration cycle produces a fine, sterile ash that can be thrown in the trash.
- Ash is space-saving; as little as one tablespoon of ash is generated on average per use.

- Incinerating toilet systems are portable, simple to install, and easy to use. Can be installed in remote areas, either for temporary or permanent use. Can be installed in unheated shelters, even in freezing temperatures.

- Relatively odorless in comparison to more commonly used storage-in-disinfectant portable toilets.

- In most areas, can be used in unheated shelters without fear of freezing.

Disadvantages

- Incinerating process destroys nutrients in the waste; ash is inadequate for replenishing soil nutrients.

- Incinerating requires energy, resulting in higher average energy costs for users.

- Units are not entirely pollution-free; both portable electric generation (for remote locations) and propane fuel burning produce some air pollutants.

- Anti-foam agents, catalysts or other additives are typically required for use.

- Some models cannot be used while the incineration cycle is in progress.

DESIGN CRITERIA

Specific design criteria depend on the type of energy used for incineration. Incinerating toilets are designed with a chamber that receives and stores human wastes until ready for incineration. The incinerating chamber is typically composed of stainless steel or a cast nickel alloy. The chamber is accessed through a toilet seat support—part of a housing made of non-corroding fiberglass reinforced plastic or similar material—having a sealable receiving opening for introduction of wastes into the chamber. Vapor and products of combustion are fed by blower fan to a venting system which may be as simple as an exhaust pipe, or which may also incorporate an afterburner or other odor control system. Not all units can be used during the incinerating cycle. Some units require initiation of an incinerating cycle after each use while others allow for multiple uses before an incineration cycle takes place.

Electric Incinerating Toilets

The Incinolet electric incinerating toilet (Blankenship/Research Products, 1999) is designed with a paper-lined upper bowl that collects newly deposited waste. To "flush," a foot pedal is pressed causing an insulated chamber cover to lift and swing to the side while the bowl halves separate, dropping the paper liner and its contents into the chamber. When the foot pedal is released, the chamber is resealed and the bowl halves return to normal position.

Incineration is initiated by pressing a "start" button after each use of the toilet. The manufacturer does *not* recommend using the toilet multiple times between incineration cycles. The toilet can continue to be used while incineration is in progress. Once the "start" button is pressed, an electric heating unit cycles on-and-off for 60 minutes while a blower motor draws air from the chamber over a heat-activated catalyst bed designed to remove odor components. Upon leaving the catalyst bed, the air is forced out through a vent line. Makeup air for the chamber is drawn from the room in which the toilet is operating. The blower motor continues to operate after the heating cycle to cool the unit. A complete cycle takes from 1.5 to 1.75 hours.

Five models of the Incinolet electric toilet are available: two for fixed locations (one four-person capacity and one eight-person capacity); two mobile- location units for motor homes, trailers and boats (one four-person and one eight-person); and a urinal (eight-person). The smaller capacity units are designed for 120 volt service, while the larger units require 240 volts. All models retain the same fundamental design principles described above.

Gas-Fired Incinerating Toilets

Propane or natural gas-burning incinerating toilets are manufactured by Storburn International, Inc. (Storburn, 1999; Lake Geneva A&C Corp, 1977.)

These units are equipped with a three gallon storage chamber which can accommodate 40 to 60 uses before initiation of an incinerating cycle. To initiate the cycle, an anti-foaming agent is manually added to the chamber, a pilot is lit using a built-in piezo-electric igniter, and the burner is activated. This procedure automatically locks down the unit so it cannot be used while the burner is in operation. A complete incineration cycle takes approximately 4.5 hours for a full chamber.

PERFORMANCE

Evaluation of 19 On-Site Waste Treatment Systems in Southeastern Kentucky.

A comparative "blackwater" (human excrement waste) treatment study, known as the Appalachian Environmental Health Demonstration Project (AEHDP), was conducted in southeastern Kentucky during the 1970s (U.S. EPA 1980.) As part of the year study, twenty prototype systems representing several alternative treatment technologies were installed in private residences in southeastern Kentucky during 1970 and 1971, including six incinerating toilets. The region used for the study was mountainous, characterized by shallow soils, steep slopes and high groundwater, having a demonstrated need for alternative treatment methods. Further, the study was performed in a low-income area where cost of installation and operation was a critical consideration.

Two of the six toilets used in the study were Incinolet brand units and the remaining four were Destroilet brand propane-fired toilets. Since the Destroilet is no longer on the market, and was significantly different in design from propane-fired toilets available today, findings related to the Destroilet are not relevant to this Fact Sheet. Results pertaining to the Incinolet electric toilet, however, are still pertinent.

The two users of Incinolet toilets complained of incomplete waste incineration. Scraping of partly burned feces from the walls of the incinerating chamber was periodically necessary. One household using the Incinolet deemed the operating cost excessive, and abandoned the incinerating toilet in favor of their outdoor privy after approximately six months. The second household used the Incinolet for approximately three years; however, toilet use was intermittent over this period and the outdoor privy was preferred because of incomplete incineration of waste products. The second household installed a septic system to replace both the Incinolet and the privy. The study acknowledges that the Incinolet manufacturer subsequently added catalyst as an incineration aid, but notes that the basic configuration of the unit was unchanged.

Cold Weather Operation Study of a Storburn Propane Combustion Toilet

Researchers from the Alaska Area Native Health Service and from the University of Alaska, Anchorage, conducted an examination of Storburn propane combustion toilets whereby honey bucket waste was collected over nearly a month and burned in a Storburn toilet using various batch sizes and burn cycle times (Ritz and Schroeder, 1994.) All burn cycles were conducted while the toilet and propane fuel tank were located outdoors, with ambient temperatures reaching as low as -11°C. Anti-foam reagent was added to the contents of the combustion chamber before each cycle to prevent boil-over of liquid waste.

The Storburn was found to effectively reduce human wastes to ash, even at low ambient temperatures. On the coldest day tested, the exhaust temperature was measured going from -11°C to 100°C (the boiling point of water) only one minute after ignition. On average, the ash remaining after incineration amounted to 2.23 percent of the total weight of waste treated in the Storburn. Moreover, microbiological examination of the resulting ash revealed no fecal contamination. The coldest temperatures tested did adversely impact incineration, however, because the contents of the propane tank could not vaporize properly. To maintain an optimal fuel supply to the toilet, the authors of the study recommend keeping propane tanks sheltered or heated when used in sub-zero conditions.

OPERATION AND MAINTENANCE

Incinerating toilets are generally simple to operate, either involving the press of a button to begin the operating cycle or the activation of a burner. The degree of maintenance required depends on the model used. Storburn gas-fired toilets have no moving parts and routine maintenance involves periodic cleaning of the burner and regular removal of ash.

Maintenance for the electric incinerating toilet involves:

- Regular emptying of the ash collection pan.
- Cleaning of the outer stainless steel surfaces including the bowl halves.
- Periodic (every 90 days) cleaning of the blower motor with occasional replacement of the blower wheel.
- Cleaning and lubrication of the foot pedal mechanism.
- Removal of bits of paper and dust from the combustion chamber.
- Annual inspection of the catalyst.

COSTS

According to Incinolet product literature (Research Products/Blankenship), a four-user electric incinerating toilet costs $2,300; an eight-user toilet costs $2,700. The purchase cost of a propane-burning Storburn is $2,550; a natural gas-burning unit costs is $2,590. Vent kits for both types of toilet are not included in these costs.

The cost of electricity varies widely according to the location of service. Domestic retail energy prices can vary from $0.05 to $0.15 per kilowatt-hour. The Incinolet electric toilet is claimed by the manufacturer to use 2 kw-h per cycle. Assuming four users, each using the toilet every 1.5 hours for a use period of 10 hours, the electric toilet would consume approximately 53 kw-h of energy per day, or about 1,600 kw-h per month. At $0.10 per kw-h, this amounts to $160.00 per month or $1,920 annually.

According to the manufacturer, maintenance costs for the Incinolet include $0.08 per bowl liner used (one per use), a new heating coil every one to three years ($89.10 each), and a new blower fan every two years ($8.95 each). Using the same assumptions for frequency of use and replacing parts every two years, the annual maintenance cost is approximately $828.

Assuming a total purchase and installation cost of $4,000, for a 10-year service life, the average annual cost (including purchase, installation, operation and maintenance averaged over 10 years) is $3,148 in 1999 dollars for the Incinolet electric toilet.

Ritz and Schroeder performed a life-cycle cost analysis for the Storburn propane toilet (Ritz and Schroeder, 1994.) The authors calculated the annual operational cost per adult to be $233.60 and the average annual maintenance cost to be $150. Assuming a purchase and installation price of $4,000, the annual cost for four adult users averaged over a 10-year service life is $1,484 in 1994 dollars. In 1999 dollars (assuming 5 percent inflation per year), this figure is equivalent to $1,894. Since this estimate reflects unit operation under cold-weather conditions, it may be assumed that this represents the high end of the cost range; the unit would require less energy for each burn cycle when used indoors or in warmer climates, with correspondingly lower energy costs.

REFERENCES

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The mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Environmental Protection Agency.

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